

	<i>G. walleri</i> ♂.		<i>G. dorcas</i> ♂.	
	English inches.	metre.	English inches	metre.
Total length of skull.....	9·2	0·234	7·5	0·190
From anterior rim of orbit to free extremity of the præmaxillæ	4·3	0·108	3·6	0·090
From anterior rim of orbit to the occipital protuberance	6·0	0·152	4·0	0·101
From centre of the external audi- tory meatus to occipital protu- berance	2·4	0·061	1·0	0·025
From the centre of external auditory meatus to posterior rim of orbit...	1·9	0·046	1·6	0·041
Length of the præmaxillæ	2·1	0·053	2·2	0·055
Length of basicranial axis	3·7	0·093	2·8	0·071
From inferior rim of orbit to alveolus of third upper molar	·9	0·022	1·1	0·028
Greatest depth of the rami of the lower jaw in the portion under- lying the molars	·6	0·015	·8	0·020
Length of diastema of the lower jaw	2·1	0·053	1·4	0·035
Length of upper molar series	1·15	0·029	1·4	0·035
" " " premolar series ...	·8	0·020	·8	0·020
" " " lower molar series	1·3	0·032	1·5	0·038
" " " premolar series ...	·7	0·018	·8	0·020
Length of horns round the curve ...	12·0	0·305	9·0	0·230
Their circumference.....	4·4	0·111	3·8	0·096

3. Notes on the Anatomy of *Indicator major*. By A. H. GARROD, M.A., F.R.S., Prosector to the Society.

[Received October 25, 1878.]

Through the kindness of Mr. R. B. Sharpe I have had the opportunity of examining a spirit-preserved specimen of *Indicator major*, from Fantee, which enables me to lay before the Society some fresh facts in its anatomy confirmatory of its non-Cuculine affinities.

In his contributions to Orr's edition of Cuvier's 'Animal Kingdom' (1840), the late Mr. E. Blyth referred the Honey-guides to the Woodpeckers as their nearest allies¹; and this idea was expanded by him two years later in the Journal of the Asiatic Society of Bengal². In 'The Ibis' for 1870³, Mr. Sclater brought forward fresh facts in proof of the non-Cuculine affinities of the genus, and proposed to place it next to the Capitonidæ, with which, or with the Coliidæ, Mr. Blanford also in the same year showed it had its nearest relationships⁴.

The following observations tend to prove the correctness of the conclusions arrived at by the two last-mentioned ornithologists, and the error of imagining that *Indicator* is related to the Cuculidæ.

¹ *Loc. cit.* p. 215.

² Vol. xi. p. 167, 1842.

³ p. 176.

⁴ Observations on the Geology and Zoology of Abyssinia, 1870, p. 308.

Pterylosis.—This has been recorded by Nitzsch in his ‘Pterylography;’ and it seems more than strange that the characteristically Picine distribution of its feather-tracts did not lead that able ornithologist to recognize its true relationships. He retained it among the Cuculidæ.

My study of Pterylography has led me to look upon the nature of the dorsal tract as all-important in determining to which great group of Birds, the Homalognatæ or Anomalognatæ¹, any doubtful family belongs. When the dorsal tract develops a fork *between* the shoulder-blades a bird is homalognatous; when the tract runs on unenlarged to near the lower ends of the scapulæ, then it is anomalognatous. Again, among the Anomalognatæ, when the pectoral tract bifurcates into an outer and an inner branch just after commencing on the chest, then the bird is one of the Piciformes, and has a tufted oil-gland; when the pectoral tract does not bifurcate at all, or only at the lower end of its pectoral portion, but is only increased in breadth instead, then the bird is Passeriform², and has a naked oil-gland. Exceptions to these rules scarcely exist.

In that the dorsal tract of *Indicator* does not form a fork, but remains narrow, between the shoulder-blades, it is anomalognatous—the Cuculidæ being homalognatous; in that it possesses a free outer pectoral band to the anterior tract, it is a Piciform bird. The oil-gland is also tufted.

A careful examination of the skin proves that the genus agrees more closely in its feather-tracts with the Picidæ, Capitonidæ, and Ramphastidæ than Nitzsch’s figures would tend to prove. To me it is evident that there is a communication between the thoracic extremity of the inferior neck-tract and the upper extremity of the humeral tract, as in the Picidæ, Capitonidæ, and Ramphastidæ. Again, in the three groups just named there is a great weakness or an entire disappearance for a short distance of the dorsal tract towards the lower extremity of the interscapular region. In *Indicator* this same weakness exists; so that, with the exception of a single feather in the middle line, the appearance of the region in question is much more like the arrangement in *Ramphastos* than in Nitzsch’s figure of the genus. On the ventral surface of the fleshy tail I find a median subcircular space surrounded by feathers, as in the Picidæ and Ramphastidæ, as well as in the Capitonidæ apparently. The caudal termination of the dorsal tract agrees with the account given by Nitzsch. I could find no trace of a duplication of the lumbar tract. In the possession of twelve rectrices *Indicator* differs from the Capitonidæ and Ramphastidæ, which have ten, like the Picidæ.

Skeleton.—The specimen of the skull of *Indicator* examined by Professor Huxley³ at Mr. Sclater’s request was too imperfect for exact description. The considerable interval between the maxillo-palatines is recorded by him. I am now able to add that the vomer

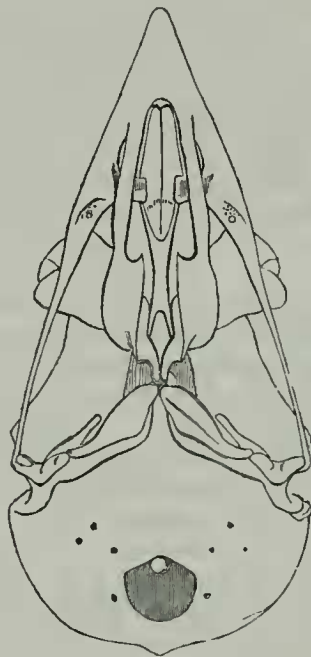
¹ Vide P. Z. S. 1874, p. 116, for definition of these terms.

² Vide P. Z. S. 1874, p. 119.

³ Ibis, 1870, p. 179.

is but little different from that of the Capitonidæ. The palate of *Megalæma asiatica* is described and figured by Professor Parker in the 'Transactions of the Linnean Society'¹. It is truncated in front and strongly bifid, the cornua running forward to blend with the maxillo-palatines. These last-named inward-directed processes of the maxillary bones blend with the mid-nasal septum in some

Fig. 1.

Palate of *Indicator*.

specimens of *Megalæma asiatica*, whilst in others they remain free from one another, separated by an inconsiderable interval. In *Pogonorhynchus bidentatus* and *Tetragonops ramphastinus* they completely blend across the middle line, without the nasal median septum persisting in front of the junction. So these two last-named species, and most probably all the species of the genera, are genuinely desmognathous.

The point in which the truncated vomer of the Capitonidæ most differs from that of the order Passeres, is that in the former the truncation occurs behind the line joining the posterior angles of the maxillo-palatines, whilst in the latter the truncation occurs some way in front of the same transverse line. The limbs of the forked vomer in the Capitonidæ run forward to meet the posterior angles of the maxillo-palatines; in the Passeres they continue, often in cartilage alone, to the nasal labyrinth.

¹ 2nd series, Zoology, vol. i. p. 122, and pl. 23.

In *Indicator* the vomer is less ossified than in the Capitonidæ above mentioned, and is smaller; the fork is slenderer and has longer limbs, which, however, quite typically join the well separated maxillo-palatines (which advance but slightly beyond the inner margins of the palatine bones) at their posterior angles.

As the Ramphastidæ have to be mentioned so frequently in connexion with the genus under consideration, it may be useful to refer to the vomer of this family. By Prof. Huxley it is included among his Coceygomorphæ, in which the vomer, if present, is pointed anteriorly. Prof. Huxley further remarks¹ that in *Ramphastos* "the antero-internal angles of the palatines not only meet, but are united by bone." But close examination demonstrates a *large tabular truncation* of the anterior extremity in the Ramphastine vomer, which I cannot help thinking Prof. Huxley interpreted as a median osseous bridge formed by the (supposed) blending of the antero-internal angles of the palatines. Figure 2 represents the vomer of

Fig. 2.



Palatal aspect of the truncated vomer of *Ramphastos ariel*, with the posterior parts of the palatine bones retained in union with it.

Ramphastos ariel, freed from its surroundings. It does not send forward limbs to join the maxillo-palatines [which are those of the desmognathous Capitonidæ inflated], but helps by its terminal expansion to complete, by contact or ankylosis with the palatine on either side, the posterior wall of a cavity in the dried skull, bounded laterally and superiorly by the inflated and infused maxillo-palatines, anteriorly by the nasal septum together with ossifications in the nasal cartilages associated with it.

In the 'Transactions' of the Linnean Society² Prof. Parker describes the vomer of *Ramphastos toco* as double, it being composed of a smaller posterior and a larger anterior bone, the truncated nature of which I am not able to infer from the account given.

The Capitonidæ, the Ramphastidæ, and *Indicator* are intimately associated, therefore, so far as the vomer is concerned. Nevertheless the proportionally great length of the limbs of the vomerine fork in the last-named form, and the considerable separation of its small

¹ P. Z. S. 1867, p. 444.

² Linn. Trans. 2nd ser. vol. i. p. 127.

maxillo-palatines, are characters which tend to bring it nearer than either of the others to the Picidæ.

The pterygoid bones of *Indicator* are much flattened from above downwards, with thin outer and inner margins, which are curved, a triangular groove on the palatal surface running from end to end. In the Capitonidæ and Ramphastidæ these bones are much more cylindroid, the superior surface alone being thin-edged, whilst in the Picidæ they are thin, as in *Indicator*, but differ in possessing a large anteriorly directed process springing from the superior surface of each.

In *Indicator* there is a small notch in the middle of the superior margin of the osseous orbit, no trace of which exists in any of the other birds above referred to. In its external osseous nares, also, there is no tendency towards the Ramphastine position of those orifices, such as is so well marked in *Tetragonops*; the alinasal ossification that tends to divide each of the nares into an anterior and a posterior moiety is likewise far less considerable than in *Megalæma*.

As is known, and well illustrated in Mr. Sclater's figure of the bone (*Ibis*, 1870, p. 178), the sternum agrees most closely with that of the Capitonidæ and Ramphastidæ; and this is especially the case in the imperfect development of the posterior extremity of the median xiphoid process, which in the Picidæ continues further onward to reach the level of the ends of the lateral xiphoid processes, at the same time that the manubrial rostrum of the last-named family only of the group is bifid. As to the posterior sternal notches, the inner is the deeper; and the same is the case in *Gecinus viridis*, whilst in *Picus*, the Capitonidæ, and Ramphastidæ the outer is the deeper.

In its soft parts *Indicator* agrees with the Capitonidæ, Ramphastidæ, and Picidæ, and differs from the Cuculidæ, in the following particulars:—There is only one carotid artery, the left; the ambiens and the accessory femoro-caudal muscles are absent (the latter of these is wanting in the Tree-Cuckoos); there are no colic cæca. The femoro-caudal, semitendinosus and accessory semitendinosus are present, as is the large gluteus. The tensor patagii brevis muscle of the wing is inserted into the extensor metacarpi radialis longus exactly as in the Capitonidæ, Ramphastidæ, and Picidæ, and as in no other birds¹. As in these three groups also (and in the Galbulidæ, but not in the scansorial Cuculidæ and Psittaci), the deep plantar tendons are distributed peculiarly—the flexor profundus digitorum supplying the third digit only, whilst the flexor longus hallucis sends slips to digits i. ii. and iv., as well as a vinculum to its companion muscle². The trachea at its lower end (fig. 3, p. 935) consolidates into a bony box, formed by the fusion of the lowermost rings. To the enlarged uppermost bronchial half-ring (*a a*) the single slender intrinsic muscle of each side fans out to be attached at its middle.

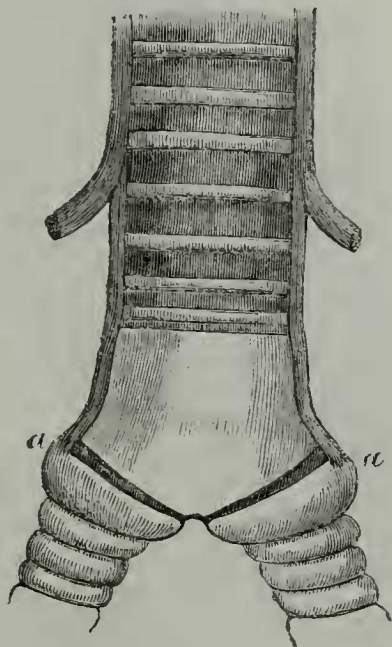
Summing up the results of the above analysis, it may be stated that, among the Piciform birds, pterylosis, osteology, myology, and visceral anatomy place the Picidæ, *Indicator*, the Capitonidæ, and

¹ *Vide* P. Z. S. 1876, p. 508, pl. xlviii. fig. 1.

² *Vide* P. Z. S. 1875, p. 346.

the Ramphastidæ in one great group of subordinal importance (if the peculiar hammer skull of the Picidæ be omitted from consideration). In this suborder the Picidæ constitute one main division—a family; whilst I, for one, cannot separate off the Capitonidæ from the Ramphastidæ by any well marked differences, the two sub-families graduating into one another.

Fig. 3.



Syrinx of *Indicator major* (enlarged); anterior aspect.

Indicator must, in my opinion, also be placed in this family, from all members of which it differs in possessing an extra pair of rectrices. No one, however, objects to keeping all the Momotidæ together because of a similar difference in some of its genera; why remove *Indicator* therefore from its allies? Nevertheless *Indicator* is not exactly like a Capitonine bird in certain details, so may be placed as a subfamily by itself, the Indicatorinæ; and the whole series may be thus tabulated.

Order.	Suborder.	Family.	Subfamily.
Piciformes.	Pici.	{ Picidæ. Capitonidæ.	{ Indicatorinæ. Capitoninæ. Ramphastinæ.